Fermilab Directorate

MEMORANDUM OF UNDERSTANDING FOR THE 2005 MESON TEST BEAM PROGRAM

T950

Vacuum Straw Tracker Test Beam Run

August 4, 2005

INTRODUCTION

This memorandum of understanding requests beam time at Fermilab during the 2005 Meson Test Beam run to measure the detection inefficiency of vacuum straw tubes. One of the future kaon experiments at J-PARC has the goal to measure the branching ratio of the neutral kaon "Golden Mode" $K_L \rightarrow \pi^0 \nu \nu$ with a few hundred event sensitivity. This future J-PARC experiment is a follow up of a current KEK experiment, E391a which has been taking data since February 2004. E391a is a collaboration of five countries (Japan, United States, Russia, Korea, and Taiwan) with ten institutions (KEK, Saga U, Yamagata U, Osaka U, U of Chicago, Pusan U, JINR, NDA, Kyoto U, National Taiwan U, and RCNP).

The branching ratio of $K_L \rightarrow \pi^0 \nu \nu$ is small, about 3×10^{-11}. To first order, all kaon decays with final states with charged particles need to be vetoed, and those include K_{e3}, $K_{\mu 3}$, and K_{+-0} (about 80% of all neutral kaon decay). The standard and typical veto power comes from sheet scintillator and may not be adequate. Vacuum straw tubes provides additional, independent and orthogonal veto power, but the detection inefficiency has not been known or measured in a detail way. The inefficiency of the straw has three sources, the electronics, the straw wall/wire, and the gas. We like to perform beam test to measure all three sources.

There is much experience in straw detector technology, and some in vacuum straw technology (CKM R&D effort). The possible use of straws in the future $K_L \rightarrow \pi^0 \nu \nu$ experiment will allow absolute photon/electron energy calibration (via K_{+-0} decays), possible measurement of photon inefficiencies (via K_{000} with π^0 Dalitz), and as mentioned, charged particle veto. The results of this proposed beam test will provide new knowledge on the absorption cross section and will direct us on design issues for future neutral kaon decay experiments.

Regarding the straws, lots of R&D work has been done by the CKM collaboration, and we plan to use as much existing straws setup and related equipment as possible.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and University of Chicago High Energy experimenters who have committed to participate in beam tests to be carried out during the Summer-Fall, 2005 MTBF program. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum which will reflect such required adjustments.

I. PERSONNEL AND INSTITUTIONS:

Spokesman and Physicist in charge of beam tests:	Yau Wah, The University of Chicago.
Fermilab liaison:	Erik Ramberg

The collaboration members at present are:

1.1 The University of Chicago: Robert Lucero, Marvin Lowenthal, Elizabeth Pod, Yau Wah

1.2 Osaka University: Mitsuhiro Yamaga, Taku Yamanaka

1.3 Fermilab: Hogan Nguyen, John Krider

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 LOCATION

2.1.1 The experiment is to take place in the MTEST beam line and located in the area designated MT6-B2. In addition, the main control room to the west of the MTEST line will be used to house electronics (up to two 19" racks of electronics)

2.1.2 Additional work space will be needed in this control room, equivalent to at most two 6'x3' tables. This space will be used for computing and general work space.

2.2 BEAM

2.2.1 The tests require a beam of tagged, charged particles (both negative and positive pions and protons) with energy range from lowest possible (~4 GeV) to about 10-20 GeV. Most runs will be performed at 10 GeV.

2.2.2 Intensity: Variable, in the range of 1-10 KHz in an area of 1 square cm.

2.2.3 We will make use of the 4 second slow spill every 2 minutes, coming from the Main Injector. We are modifying our DAQ to take advantage of this scenario.

2.2.4 We anticipate some parasitic running during the test beams for other experiments if needed.

2.3 SETUP

2.3.1 At least one full day of access to the experimental area will be needed to set up the straw stand. This includes not only the silicon telescope planes and mechanical apparatus, but also the cable work.

2.3.2 At least one additional day will be needed to install and debug the DAQ and NIM logic associated with the trigger. This would require only sporadic access.

2.3.3 Some cabling to the counting room is needed. We have allowed one day of setup time. An outline of our cable needs between counting house and MT6-A2 include:

- Mini drift chambers (3 cond. for power, 6 cond. ribbon,)
- Vacuum straws (3 cond. for power, 6 cond. ribbon, 16 RG58 BNC coax)
- Trigger scintillators (5 RG59 SHV for voltage, 38 RG58 BNC coax)
- Power, Ethernet, DAQ interconnection cables (in counting house)

2.4 SCHEDULE

2.4.1 We are planning on beginning tests in the Fall of 2005.

2.4.2 We are requesting a few days of setup time followed by 1-2 week of regular data taking. Each run will consist of a few hours of measurements. Access to the experimental area will be needed only if equipment needs to be serviced and/or aligned.

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB

([] denotes replacement cost of existing hardware.)

3.1 University of Chicago: 3 Mini drift chambers with electronics readout and power supplies [30K]

IV. RESPONSIBILITIES BY INSTITUTION - FERMILAB

([] Denotes replacement cost of existing hardware.)

4.1 **Fermilab Accelerator Division:**

4.1.1 Use of MTest beam during our scheduled time.

4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.

4.1.3 A scaler or beam counter signal should be made available in the counting house.

4.1.4 Reasonable access to our equipment in the test beam.

4.1.5 The test beam energy and beam line elements will be under the control of the AD Operations Department Main Control Room (MCR).

4.1.6 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage. (0.5 person-weeks)

4.1.7 The use of negative beam should be reviewed by the Accelerator Division ES&H Department as part of the Operational Readiness Clearance process.

4.1.8 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate or MINOS extraction by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.2 Fermilab Particle Physics Division

4.2.1 The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2.

4.2.2 The Fermilab PPD will be responsible for coordinating overall activities in the MTest beamline, including the use of the user beamline controls, readout of the beamline detectors and the MTest gateway computer. (0.5 person-weeks)

4.2.3 Cooling water (or a chiller) and dry nitrogen (for electronics) should be provided.

4.2.4 Adequate lighting for the MT6-B2 area is requested

4.2.5 The existing CKM straws prototype setup including the straws, associated electronics, gas system and readout will be provided.

4.2.6 Gas (Ar/CO2-80/20) will be provided for the mini drift chambers. ($100)

4.3 Fermilab Computing Division

4.3.1 Ethernet and printers should be available in the counting house.

4.3.2 Connection to beams control console and remote logging (ACNET) should be made available in the counting house.

4.3.3 See Appendix II for a summary of PREP equipment pool needs.

4.4 Fermilab ES&H Section

4.4.1 Assistance with safety reviews.

4.4.2 Loan of radioactive source (preferably Sr^{90}, 5mCi) for the duration of the test beam.

V. SUMMARY OF COSTS

Source of Funds [$K]	Equipment	Operating	Personnel (person-weeks)
Particle Physics Division	$0.0K	$0.1K	0.5
Accelerator Division	0	0	0.5
Computing Division	0	0	0
Totals Fermilab	$0.0K	0.1	0.5
Totals Non-Fermilab	[$30K]		

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the Vacuum Straw Tracker Group Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Physicist in charge agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The Vacuum Straw Tracker Group Spokesperson will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.

6.3 The Vacuum Straw Tracker Group Spokesperson will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.5 All items in the Fermilab Policy on Computing will be followed by experimenters.

6.6 The Vacuum Straw Tracker Group Spokesperson will undertake to ensure that no PREP and computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 Each institution will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.8 If the experiment brings to Fermilab on-line data acquisition or data communications equipment to be integrated with Fermilab owned equipment, early consultation with the Computing Division is advised.

6.9 At the completion of the experiment:

6.9.1 The Vacuum Straw Tracker Group Spokesperson is responsible for the return of all PREP equipment, Computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the Vacuum Straw Tracker Group Spokesperson will be required to furnish, in writing, an explanation for any non-return.

6.9.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

6.9.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

6.9.4 An experimenter will report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

_____ / / 2005
Yau Wah, The University of Chicago

_____ / / 2005
Jim Strait, Particle Physics Division

_____ / / 2005
Roger Dixon, Accelerator Division

_____ / / 2005
Robert Tschirhart, Computing Division

_____ / / 2005
William Griffing, ES&H Section

_____ / /2005
Hugh Montgomery, Associate Director for Research,

_____ / /2005
Steven Holmes, Associate Director for Accelerators,

APPENDIX I –VACUUM STRAW BEAM TEST – EQUIPMENT POOL NEEDS

Equipment Pool items needed for Fermilab test beam, needed on the first day of setup:

Quantity	Description
4	Nim crates, with cooling fans
1	Fluke 5kV high voltage power supply
1	Berkeley Cow high voltage distribution box
5	NIM Octal descriminators Lecroy 623
4	NIM logic fan in/out Lecroy 429a
2	NIM Scalers modules (4 channels total)
4	NIM Tri- coincidence logic Lecroy 465
3	NIM quad-coin. logic Lecroy 622
4	MWPC wire chamber NIM power supplies (positive HV)
1	pulse gen. fast risetime (<5ns) +- 20v
1	analogue or digital oscilliscope
10	CAMAC 3377 TDCs

APPENDIX II - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		Electrical Equipment		Hazardous/Toxic Materials	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		capacitor banks		planned for use in a beam line or experimental enclosure:
	Target	X	high voltage		
	Bubble chamber	X	exposed equipment over 50 V		
Pressure Vessels		**Flammable Gases or Liquids**			
	inside diameter	Type:			
	operating pressure	Flow rate:			
	window material	Capacity:			
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter	X	temporary use		Beryllium (Be)
	operating pressure	Type:	**Sr90**		Lithium (Li)
	window material	Strength:	**5 mCi**		Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other :
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA		Motion controllers
Wattage:			photographic developers		scaffolding/elevated platforms
class:			Other: Activated Water?		Others